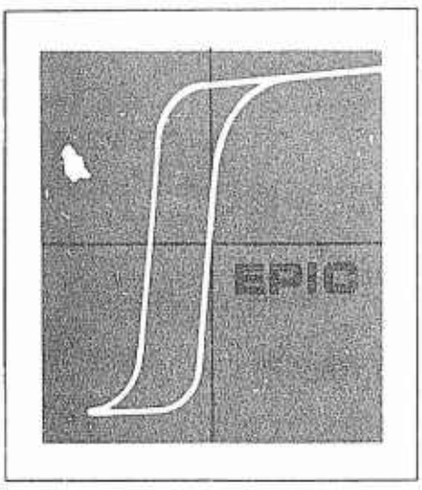
CONTRACT AF 33 616 8439
PROJECT 7381 TASK 738103

# PYROCERAM

Data Sheets

John T. Milek

DS-130
August 1963




ELECTRONIC PROPERTIES INFORMATION CENTER

HUGHES
HUGHES AIRCRAFT COMPANY
CULVER CITY CALIFORNIA

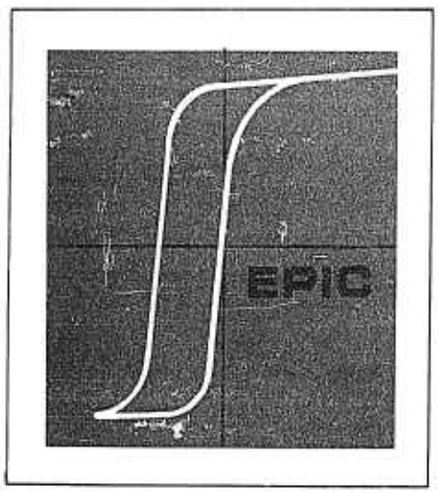
CONTRACT AF 33(616)-8438
PROJECT 7381; TASK 738103

# PYROCERAM

## Data Sheets

John T. Milek

DS-130
August 1963




ELECTRONIC PROPERTIES INFORMATION CENTER

HUGHES
HUGHES AIRCRAFT COMPANY
CULVER CITY, CALIFORNIA

# FOREWORD

This report was prepared by Hughes Aircraft Company under Contract No. AF 33(616)-8438. The contract was initiated under Project No. 7381, Task No. 738103. The work was administered under the direction of the Directorate of Materials and Processes, Aeronautical Systems Division, with Mr. R.F. Klinger acting as Project Engineer.

Many persons have contributed to the program which this report represents. The author wishes especially to acknowledge the contributions of the following: J.J. Anders, J.W. Atwood, C.L. Blocher, D.L. Grigsby, F.S. Harter, D.H. Johnson, H.T. Johnson, M.S. Neuberger, and E. Schafer.

## ABSTRACT

The Electronic Properties Information Center has been established to collect, index and abstract the literature on the electrical and electronic properties of materials and to evaluate and compile the experimental data from that literature. A modified coordinate index to the literature is machine stored and printed for manual use. The Center publishes data sheets, summary reports, thesauri, glossaries, and similar publications as sufficient information is evaluated and compiled. This report consists of the compiled data sheets on Pyroceram.


This report has been reviewed and is approved for publication.

H. Thayne Johnson, Supervisor
Electronic Properties Information Center

John W. Atwood
Project Manager

TABLE OF CONTENTS

# INTRODUCTION

In June 1961, a program was initiated under the direction of the Air Force to collect, index and abstract the literature on the electrical and electronic properties of materials and to evaluate and compile the experimental data from that literature. Placed at Hughes Aircraft Company in Culver City, California, the program, now called the Electronic Properties Information Center, was originally intended to cover ten major categories of materials: Semiconductors, Insulators, Ceramics, Ferroelectrics, Metals, Ferrites, Ferromagnetics, Electroluminescent Materials, Thermionic Emitters, and Superconductors.

During the first year, studies were completed on the Semiconductor and Insulator categories; and Ceramics was discontinued as a separate category and subsumed under the other nine. Vocabulary studies have now been completed on all categories, and retrospective documentation is virtually complete for Semiconductors and Insulators. A full index to the literature is maintained; and publications such as data sheets, summary reviews, glossaries, and thesauri are periodically issued. The use of the Center and these publications are available to anyone wishing information within the scope of the Center's objectives. A full list of publications to date appears at the end of this report.

This report contains data sheets on Pyroceram. The data sheets have been compiled direct from the literature. Articles are allowed to accumulate in the system until it is judged that a sufficient number are available on one material for adequate evaluation. The manual

modified coordinate index is then used to retrieve all literature on the material to be compiled. Bibliographies are checked to make sure that valuable and relevant literature is not overlooked. Then the assembled literature is given to the specialist doing the evaluation and compilation.

Evaluation is confined to primary source data except when only secondary citations are available. If equally valid data are available from several sources, all are given. Data are rejected when judged questionable because of faulty or dubious measurements, unknown sample composition, or if more reliable data are available from another source. Selection of data is based upon that which is judged most representative, precise, reliable, and covers the widest range of variables. The addition of new data to a previously evaluated property requires a reappraisal of the reported values. Older data may be deleted if the new data are judged more accurate or representative.

After a thorough analysis and evaluation, the data is compiled into data sheets which present it in its most optimum form. This will be, primarily, but not limited to, curves or tabular form. Where possible, graphs are adapted directly from the original sources. If this is not possible, they are drawn from data compiled from the articles. Where thought important, notes are entered with each graph to help the user.

The references, from which the data are drawn, are shown by

reference number below each graph with the full bibliographic information at the end of the data sheets. The bibliography is referred to and listed in the order of entry into the Center (accession number). This provides a quick cross reference into the index used with the literature.

This compilation deals only with Pyroceram as an Insulator. Non-insulator data will be included in a future revision.

## MATERIALS DESCRIPTION

Pyroceram is a new family of glass materials developed by Corning Glass Works in the past few years. It is essentially a crystalline material formed from a non-crystalline glass.

A glass batch containing one or more nucleating agents is melted, formed, and cooled. Subsequent heat treatments cause the nucleating agents to form billions of submicroscopic crystallites per cubic millimeter in the pyroceram. The end product, after heat treatment, is a fine grained crystalline material, non-porous and reportedly harder than most ceramics and many metals.

Pyroceram can be formed by conventional glass-forming methods: blowing, drawing, pressing, rolling, and casting.

Corning Glass Works has two types of pyroceram available (commercially) as Code 9606 and 9608.

Present electronic applications include missile nose cones (radomes and contural windows for hypersonic aircraft).

# INSULATION MATERIALS

August 1963

PYROCERAM - Corning 889 CA*

Dielectric Constant

| Temperature (°C) | Frequency (CPS) | $\varepsilon'$ |
|---|---|---|
| 25 | 60 | 5.8 |
| 25 | $10^6$ | 5.9 |
| 500 | $10^6$ | 5.8 |

[Ref. 5633]

Dissipation Factor

| Temperature (°C) | Frequency (CPS) | Tan $\delta$ |
|---|---|---|
| 25 | 60 | 0.008 |
| 25 | $10^6$ | 0.0008 |
| 500 | $10^6$ | 0.04 |

[Ref. 5633]

Volume Resistivity

| Temperature (°C) | $\rho$ (ohm cm) | Ref. |
|---|---|---|
| 500 | $10^{10}$ | 5633 |

*This glass composition is no longer commercially available.

## INSULATION MATERIALS

August 1963

PYROCERAM - Corning 7911*

Dielectric Constant

| Temperature (°C) | Frequency (CPS) | ε' |
|---|---|---|
| 25 | $10^6$ | 3.8 |
| 500 | $10^6$ | 2.9 |
| 500 | $10^{10}$ | 3.75 |

[Ref. 5633]

Dissipation Factor

| Temperature (°C) | Frequency (CPS) | Tan δ |
|---|---|---|
| 25 | $10^6$ | 0.0002 |
| 25 | $10^{10}$ | 0.00055 |
| 500 | $10^6$ | 0.12 |
| 500 | $10^{10}$ | 0.0017 |

[Ref. 5633]

Volume Resistivity

| Temperature (°C) | ρ (ohm cm) |
|---|---|
| 500 | $10^9$ |

[Ref. 5633]

*This glass composition is no longer commercially available.

# INSULATION MATERIALS

August 1963

PYROCERAM - Corning 8605*

Dielectric Constant

| Temperature (°C) | Frequency (CPS) | ε' | Ref. |
|---|---|---|---|
| 25 | $10^6$ | 6.1 | 5796, 4836 |
| 25 | $10^{10}$ | 6.1 | 5796, 5633 |
| 300 | $10^6$ | 6.3 | 4836 |
| 500 | $10^{10}$ | 6.1 | 5633 |

Dissipation Factor

| Temperature (°C) | Frequency (CPS) | Tan δ | Ref. |
|---|---|---|---|
| 25 | $10^6$ | 0.0017 | 4836, 5796 |
| 25 | $10^{10}$ | 0.0002 | 5633, 5796 |
| 300 | $10^6$ | 0.014 | 4836 |
| 500 | $10^{10}$ | 0.0025 | 5633 |

*This glass composition is no longer commercially available.

## INSULATION MATERIALS

August 1963

PYROCERAM - Corning 8605

Loss Factor

| Temperature (°C) | Frequency (CPS) | ε" | Ref. |
|---|---|---|---|
| 25 | $10^6$ | 0.0102 | 4836, 5796 |
| 25 | $10^{10}$ | 0.0012 | 5796 |
| 300 | $10^6$ | 0.078 | 4836 |

Volume Resistivity

| Temperature (°F) | ρ (ohm cm) | Ref. |
|---|---|---|
| 500 | $10^{10.1}$ | 5796 |

## INSULATION MATERIALS

August 1963

PYROCERAM - Corning 8606*

Dielectric Constant

| Temperature (°C) | Frequency (CPS) | ε' | Ref. |
|---|---|---|---|
| 25 | $10^6$ | 5.62 | 5796, 4836 |
| 25 | $10^{10}$ | 5.53 | 5796, 5633 |
| 300 | $10^6$ | 5.80 | 4836 |
| 500 | $10^{10}$ | 5.54 | 5633 |

Dissipation Factor

| Temperature (°C) | Frequency (CPS) | Tan δ | Ref. |
|---|---|---|---|
| 25 | $10^6$ | 0.0024 | 4836, 5796 |
| 25 | $10^{10}$ | 0.0003 | 5633, 5796 |
| 300 | $10^6$ | 0.013 | 4836 |
| 500 | $10^{10}$ | 0.0018 | 5633 |

*This glass composition is now designated Corning 9606.

# INSULATION MATERIALS

August 1963

PYROCERAM - Corning 8606

Loss Factor

| Temperature (°C) | Frequency (CPS) | Loss Factor | Ref. |
|---|---|---|---|
| 25 | $10^6$ | 0.0134 | 5796, 4836 |
| 25 | $10^{10}$ | 0.0016 | 5796 |
| 300 | $10^6$ | 0.075 | 4836 |

Volume Resistivity

| Temperature (°F) | ρ (ohm cm) | Ref. |
|---|---|---|
| 500 | $10^{10}$ | 5796 |

# INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9605*

Dielectric Constant

| Temperature (°C) | Frequency (CPS) | ε' | Ref. |
|---|---|---|---|
| 25 | $10^6$ | 6.1 | 4834<br>4009 |
| 25 | $10^{10}$ | 6.1 | 4834<br>4009 |
| 300 | $10^6$ | 6.3 | 4834<br>4009 |
| 300 | $10^{10}$ | 6.1 | 4834<br>4009 |
| 500 | $10^{10}$ | 6.1 | 4834<br>4009 |

Dielectric Strength

Room temperature (?) [thickness not stated] 300 volt/mil

[Ref. 4834]

*This glass composition is no longer commercially available.

## INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9605

Dissipation Factor

| Temperature (°C) | Frequency (CPS) | Tan δ | Ref. |
|---|---|---|---|
| 25 | $10^6$ | 0.0017 | 4009 |
| 25 | $10^{10}$ | 0.0002 | 4009 |
| 300 | $10^6$ | 0.014 | 4009 |
| 300 | $10^{10}$ | 0.0008 | 4009 |
| 500 | $10^{10}$ | 0.0025 | 4009 |

Loss Factor

| Temperature (°C) | Frequency (CPS) | Loss Factor | Ref. |
|---|---|---|---|
| 25 | $10^6$ | 0.010 | 4009 |
| 25 | $10^{10}$ | 0.001 | 4009 |
| 300 | $10^6$ | 0.078 | 4009 |
| 300 | $10^{10}$ | 0.005 | 4009 |
| 500 | $10^{10}$ | 0.015 | 4009 |

Volume Resistivity

| Temperature (°F) | Resistivity (ohm cm) | Ref. |
|---|---|---|
| 68-212 | $10^{13}$ | 4834 |
| 480 | $1.1 \times 10^{10}$ | 4009 |
| 660 | $1.5 \times 10^8$ | 4009 |

## INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9606

Dielectric Constant

| Temperature (°C) | Frequency (CPS) | ε' | Ref. |
|---|---|---|---|
| 20 | $10^6$ | 5.58 | 5793, 5790 |
| 25 | $10^6$ | 6.78 | 5788 |
| 25 | $10^6$ | 5.58 | 5789, 5790 |
| 25 | $10^6$ | 5.62 | 4009 |
| 25 | $10^{10}$ | 5.45 | 5633, 5795, 5789, 5794, 5790 |
| 25 | $10^{10}$ | 5.53 | 4009 |
| 300 | $10^6$ | 5.60 | 5795, 5789, 5790 |
| 300 | $10^6$ | 5.80 | 4009 |
| 300 | $10^{10}$ | 5.51 | 5795, 5789, 5794, 5790 |
| 300 | $10^{10}$ | 5.53 | 4009 |
| 500 | $10^6$ | 8.80 | 5795, 5789, 5790 |
| 500 | $10^{10}$ | 5.53 | 5633, 5795, 5789, 5794, 5790 |
| 500 | $10^{10}$ | 5.54 | 4009 |

# DATA SHEET

ELECTRICAL AND ELECTRONIC PROPERTIES

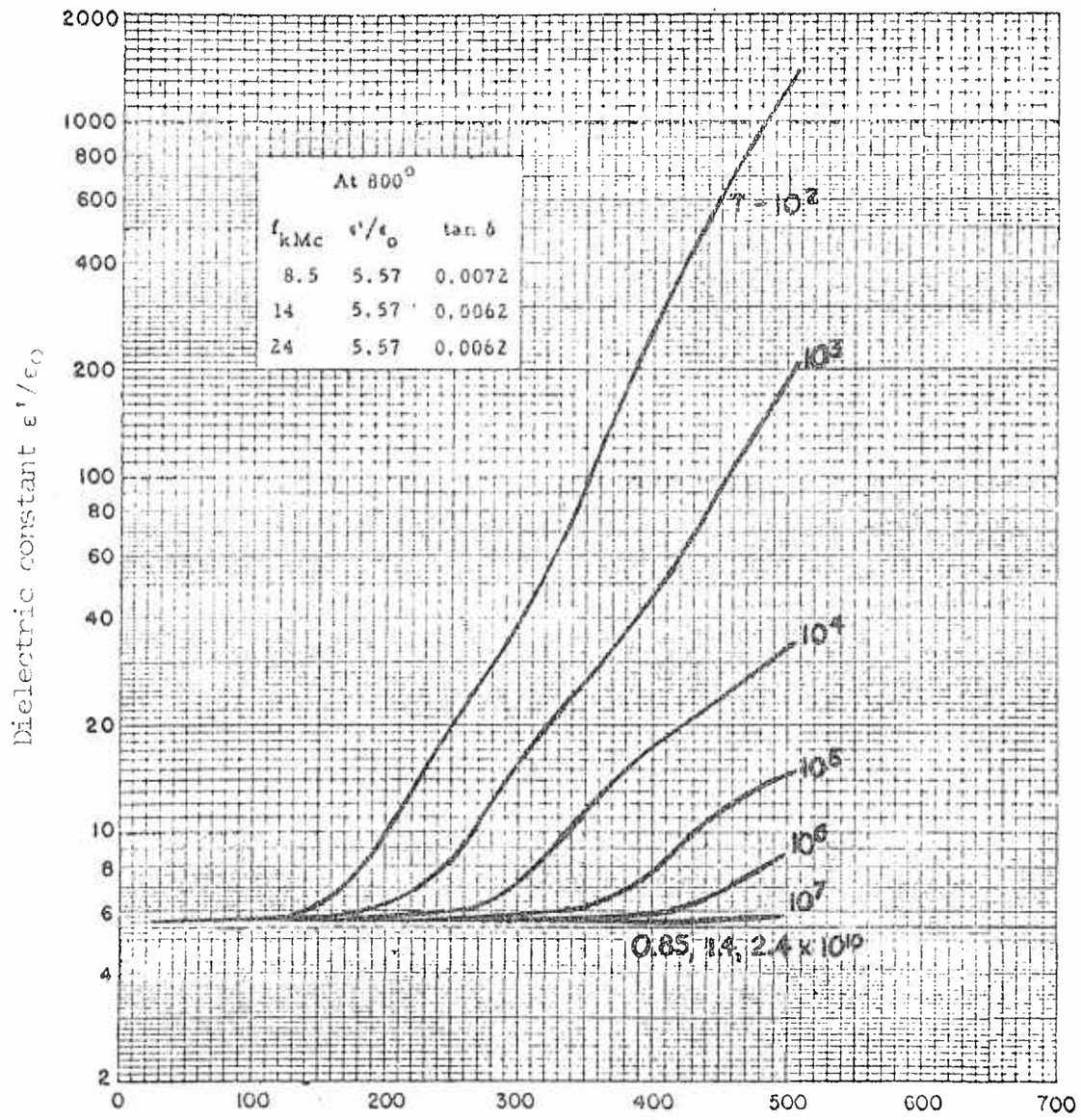
MATERIALS CENTRAL
AERONAUTICAL SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND

## INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9606

Dielectric Constant




Dielectric constant as a function of temperature.

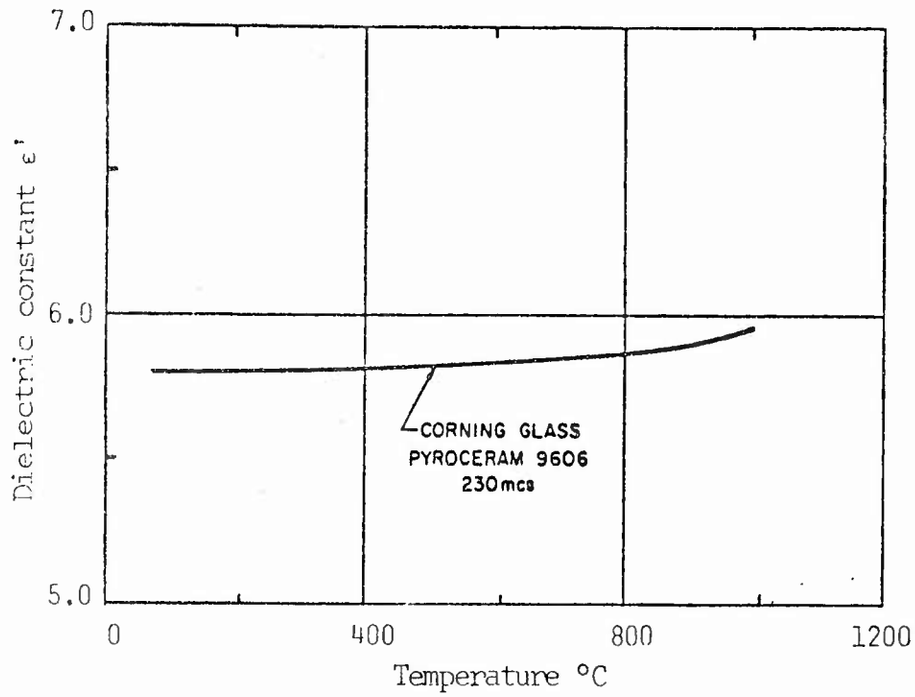
[Ref. 5788].

## INSULATION MATERIALS

August 1963

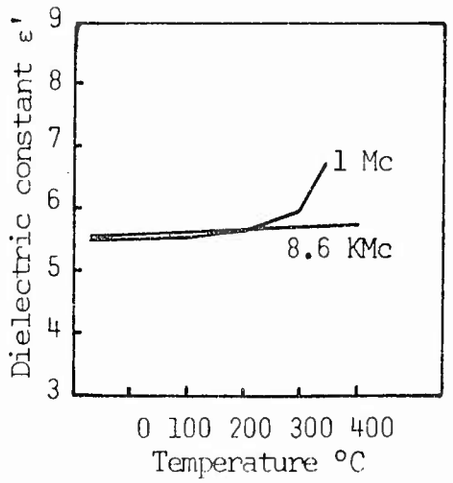
PYROCERAM - Corning 9606

Dielectric Constant




Dielectric constant as a function of temperature.

[Ref. 5742]




Dielectric constant as a function of temperature.

[Ref. 1261]

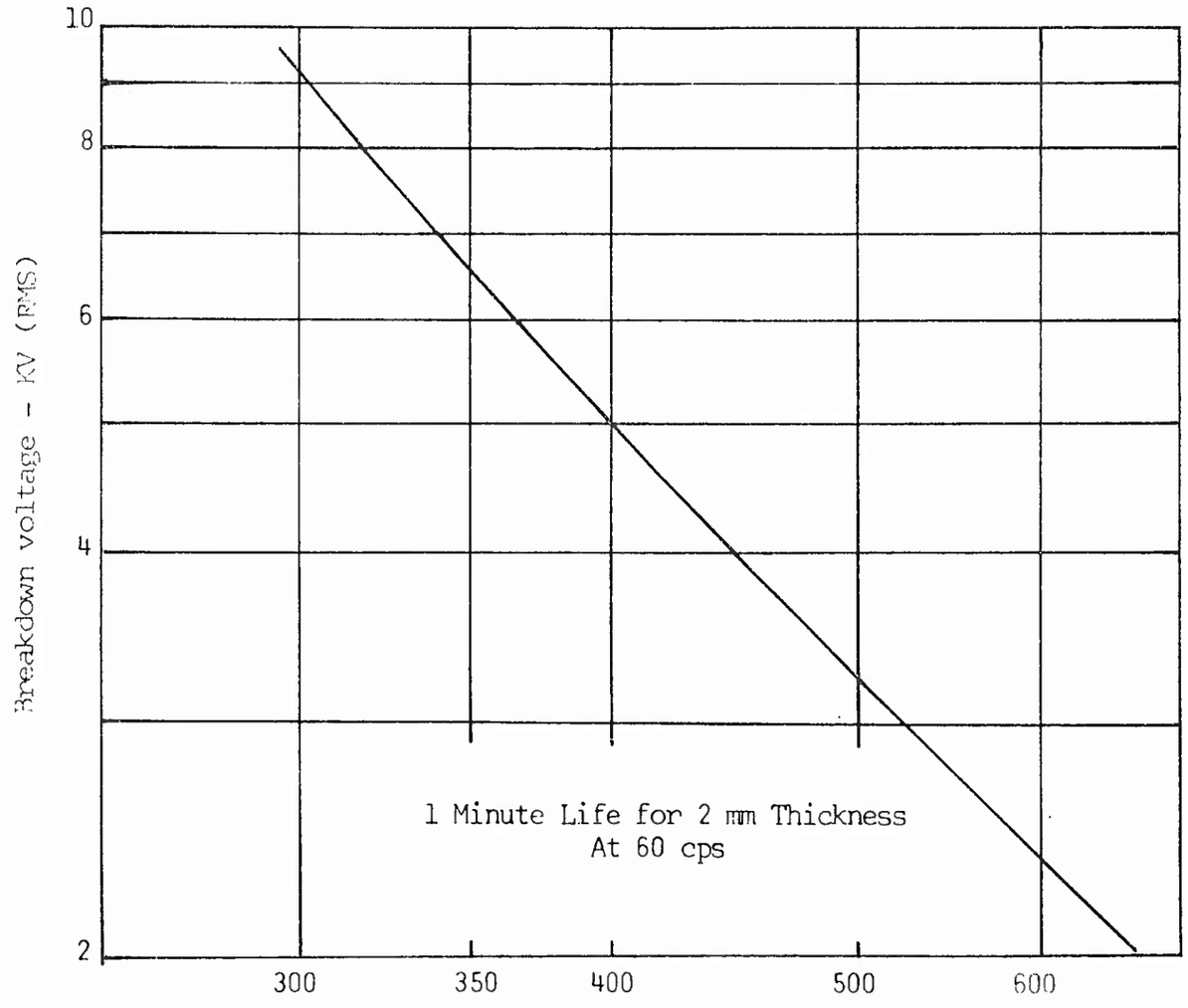
## INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9606

Dielectric Strength

68° F  0.10 inch thick  345 volts/mil  Ref. 5791




Dielectric breakdown as a function of temperature.

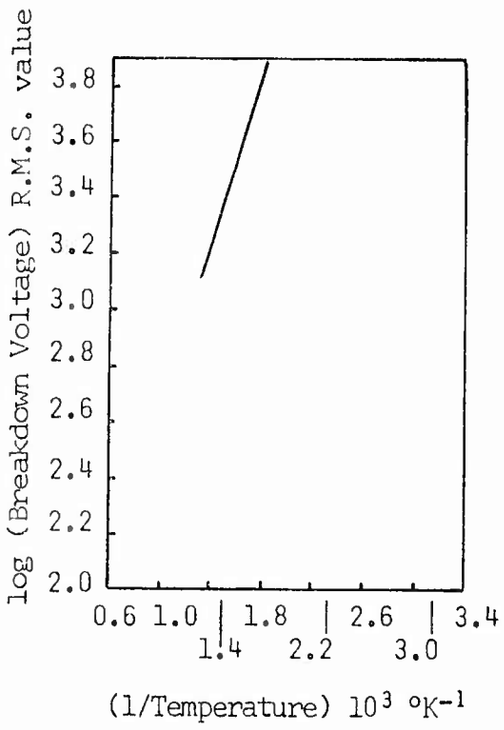
[Ref. 5788]

# INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9606

Dielectric Strength




Dielectric strength as a function of temperature for Corning 9606. One-minute breakdown for sample thickness of 2 mm at 60 CPS.

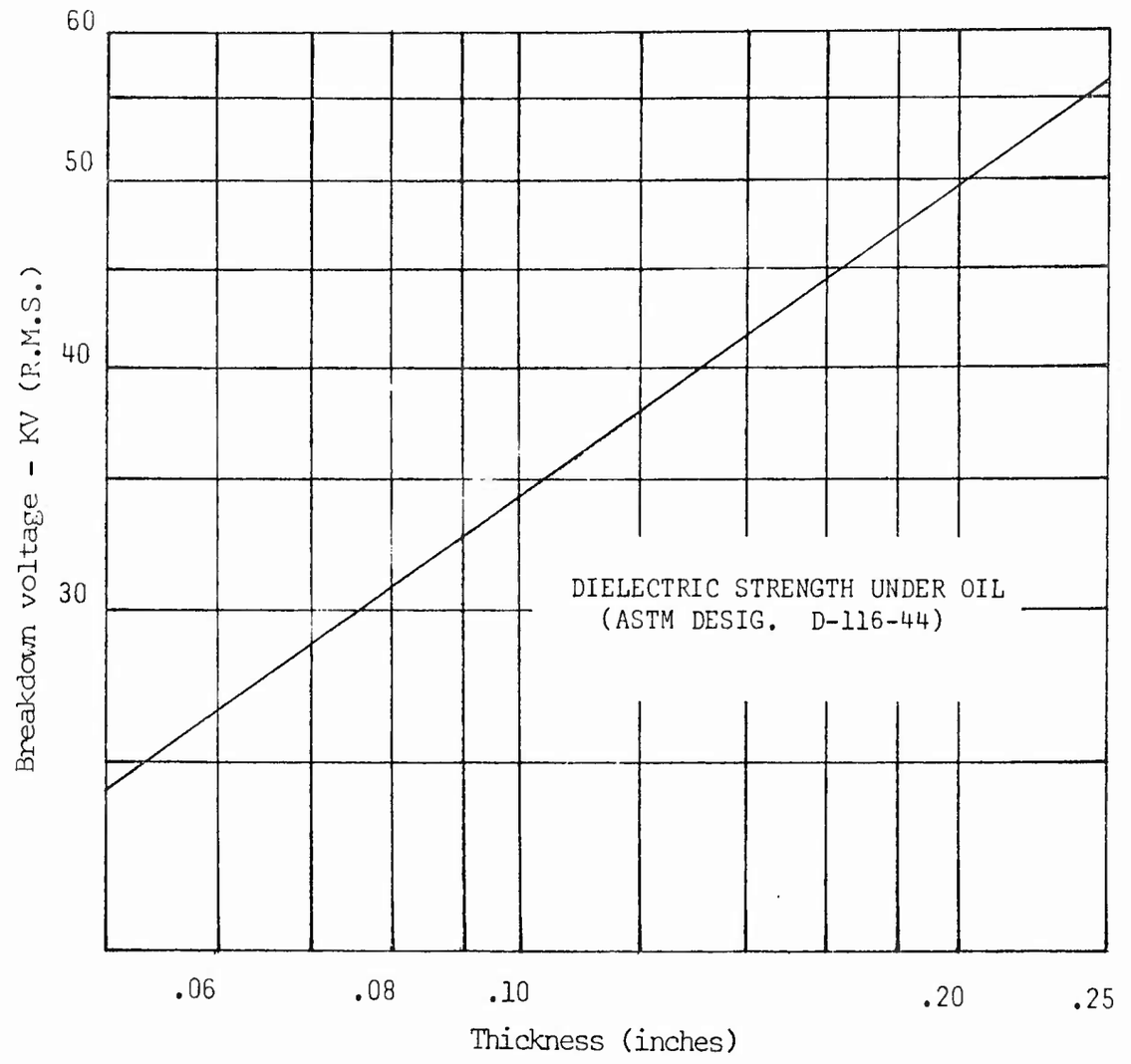
[Ref. 1261]

## INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9606

Dielectric Strength




Dielectric strength as a function of thickness at 60 CPS.

[Ref. 5788]

## INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9606

Dissipation Factor

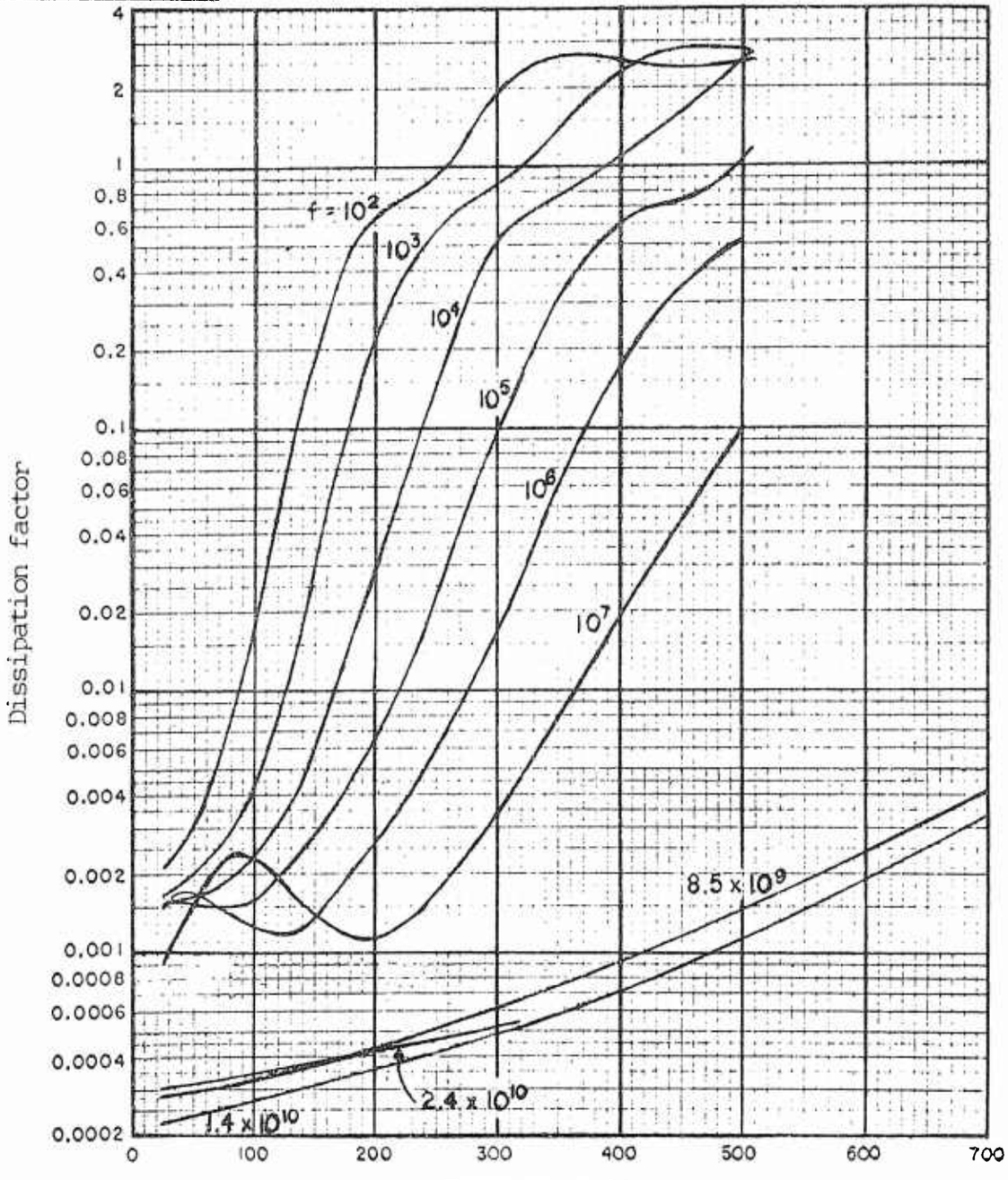
| Temperature (°C) | Frequency (CPS) | Tan δ | Ref. |
|---|---|---|---|
| 25 | 100 | 0.020 | 5791 |
| 25 | $10^6$ | 0.0030 | 5788 |
| 25 | $10^6$ | 0.0015 | 5790, 5789 |
| 25 | $10^6$ | 0.0024 | 5790, 5789 |
| 25 | $10^{10}$ | 0.00033 | 5633, 5794, 5789, 4009 |
| 25 | $10^{10}$ | 0.00083 | 5790 |
| 300 | $10^6$ | 0.0154 | 5790, 5789 |
| 300 | $10^6$ | 0.013 | 4009 |
| 300 | $10^{10}$ | 0.00075 | 5794, 5790, 5789 |
| 300 | $10^{10}$ | 0.0006 | 4009 |
| 500 | $8.5 \times 10^9$ | 0.0015 | 5791 |
| 500 | $10^{10}$ | 0.00152 | 5633, 5794, 5790, 5789 |
| 500 | $10^{10}$ | 0.0018 | 4009 |

## INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9606

Dissipation Factor



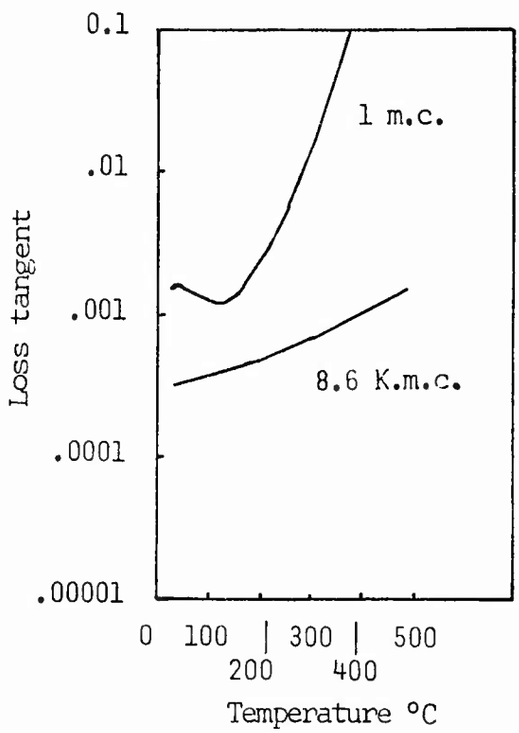

Dissipation factor as a function of temperature at various frequencies.
[Ref. 5788]

# INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9606

Dissipation Factor




Loss tangent as a function of temperature for Corning 9606 at two frequencies.

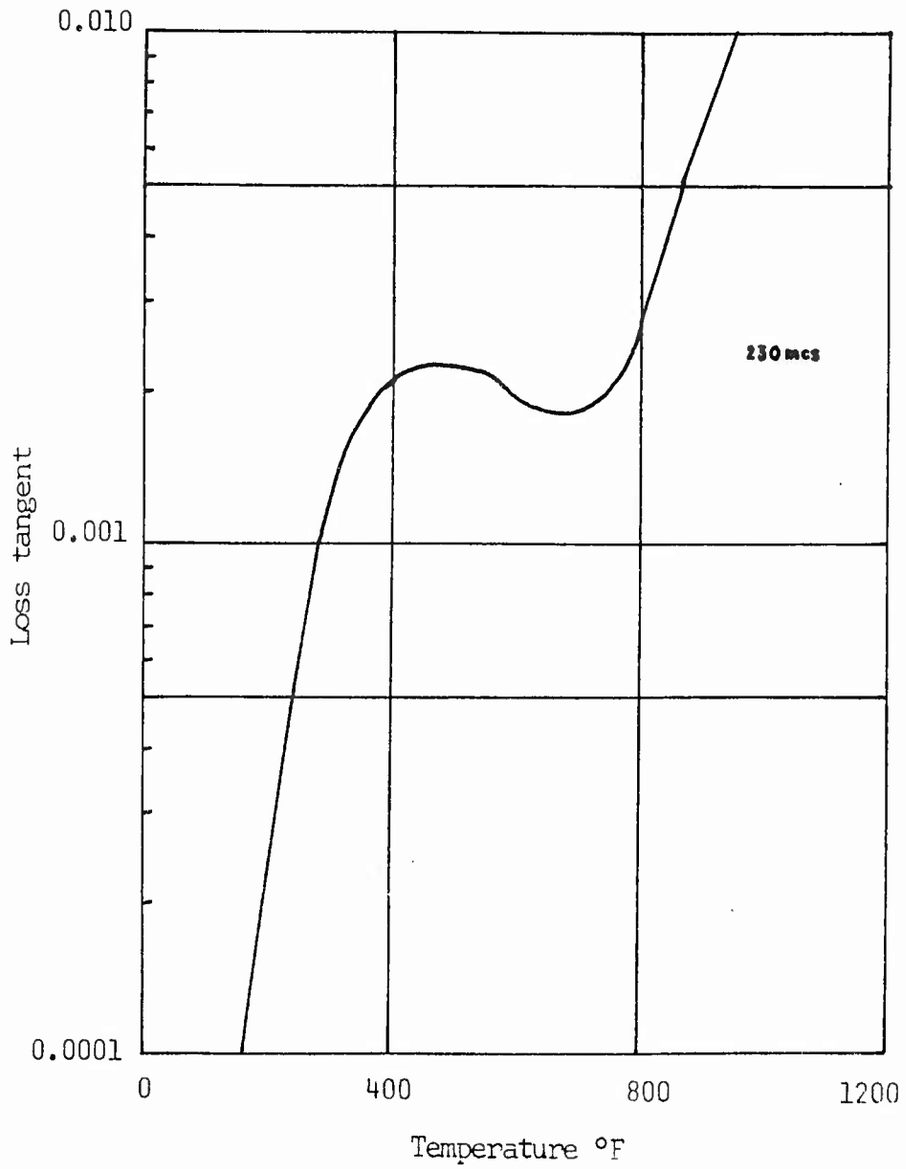
[Ref. 1261]

## INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9606

Dissipation Factor




Loss tangent as a function of temperature for Corning 9606.

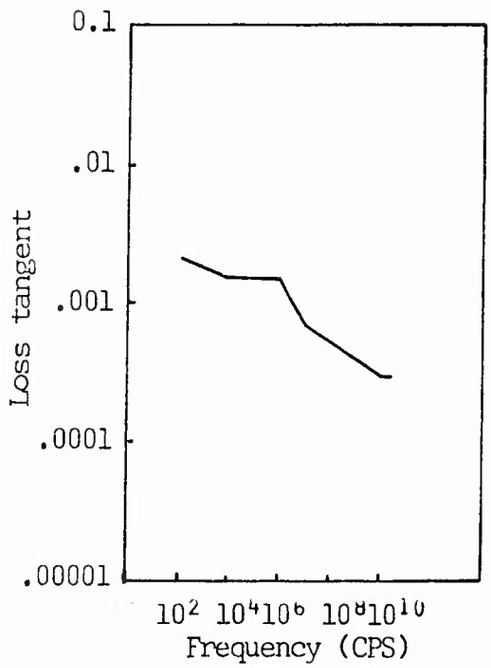
[Ref. 5742]

# INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9606

Dissipation Factor




Loss tangent as a function of frequency at room temperature.

[Ref. 1261]

# INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9606

Loss Factor

| Temperature °C | Frequency (CPS) | Loss Factor | Ref. |
|---|---|---|---|
| 20 | $10^6$ | 0.0084 | 5793 |
| 25 | $10^6$ | 0.014 | 4009 |
| 25 | $10^6$ | 0.009 | 5789, 5790 |
| 25 | $10^{10}$ | 0.002 | 4009, 5789, 5790, 5794 |
| 300 | $10^6$ | 0.075 | 4009 |
| 300 | $10^6$ | 0.086 | 5789, 5790 |
| 300 | $10^{10}$ | 0.004 | 5789, 5790, 5794 |
| 300 | $10^{10}$ | 0.003 | 4009 |
| 500 | $10^{10}$ | 0.008 | 5789, 5790, 5794 |
| 500 | $10^{10}$ | 0.010 | 4009 |

# INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9606

Volume Resistivity

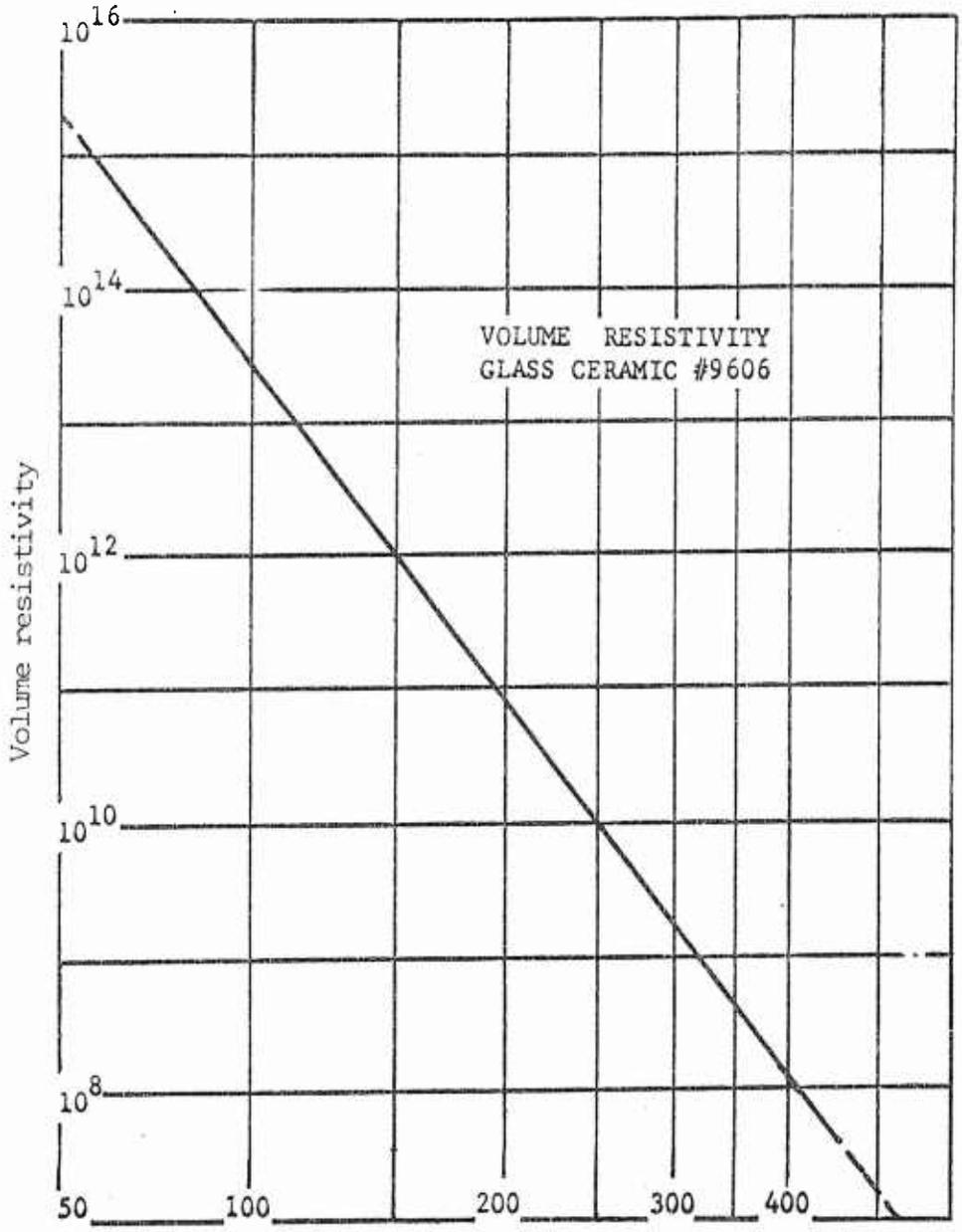
| Temperature °C | Resistivity (ohm-cm) | Ref. |
|---|---|---|
| 250 | $1.1 \times 10^8$ | 5788 |
| 250 | $10^{10}$ | 4009, 5789, 5790, 5791, 5793 |
| 350 | $1.4 \times 10^8$ | 4009, 5789, 5790, 5791, 5793 |

# INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9606

Volume Resistivity




Resistivity as a function of temperature for Corning 9606.
[Ref. 5788]

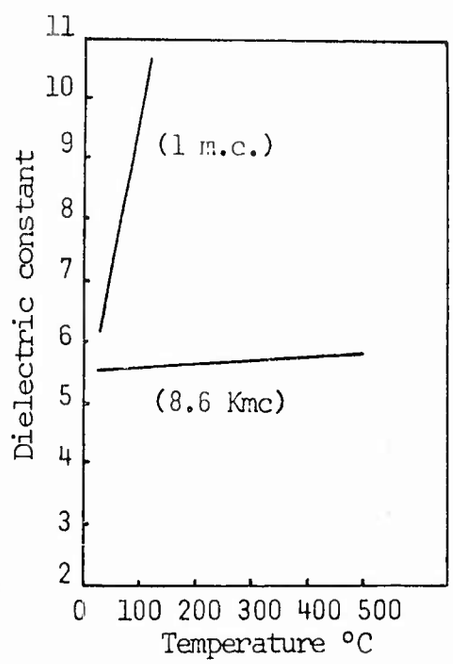
## INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9608

Dielectric Constant

| Temperature (°C) | Frequency (CPS) | ε' | Ref. |
|---|---|---|---|
| 25 | $10^2$ | 7.13 | 5791 |
| 25 | $10^6$ | 6.78 | 5789 5791 5788 5793 5790 5795 |
| 25 | $10^{10}$ | 6.54 | 5789 5791 5795 |
| 300 | $10^{10}$ | 6.65 | 5789 5791 5795 |
| 500 | $10^{10}$ | 6.78 | 5789 5791 5795 |




Dielectric constant as a function of temperature for Corning 9608 at two frequencies.

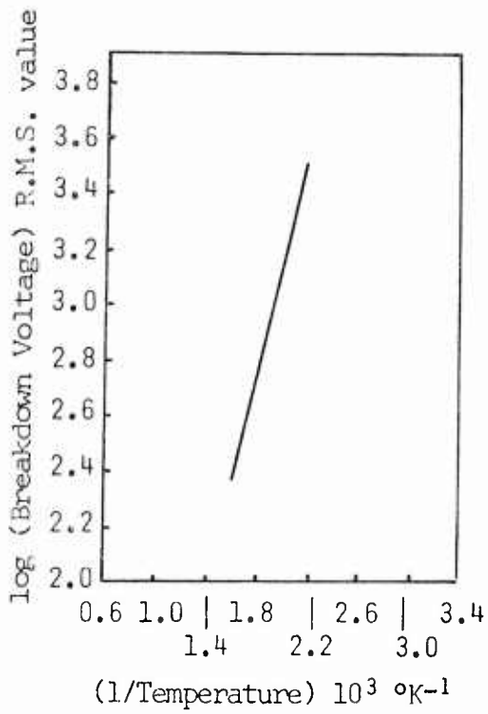
[Ref. 1261]

# INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9608

Dielectric Strength




Dielectric strength as a function of temperature for Corning 9608. One-minute breakdown for sample thickness of 2 mm at 60 CPS.

[Ref. 1261]

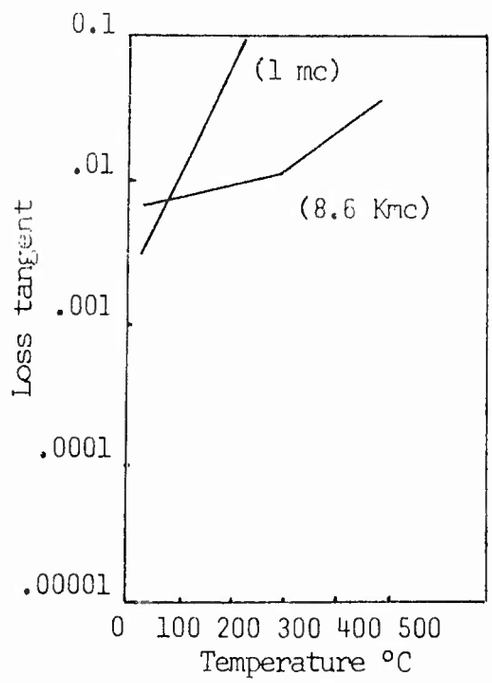
# INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9608

Dissipation Factor

| Temperature (°C) | Frequency (CPS) | Tan δ | Ref. |
|---|---|---|---|
| 25 | $10^2$ | 0.020 | 5789 |
| 25 | $10^6$ | 0.0030 | 5788<br>5789<br>5790 |
| 25 | $10^{10}$ | 0.0068 | 5789<br>5791 |
| 300 | $10^{10}$ | 0.0115 | 5789<br>5791 |
| 500 | $10^{10}$ | 0.040 | 5789<br>5791 |




Loss tangent as a function of temperature for Corning 9808 at two frequencies.

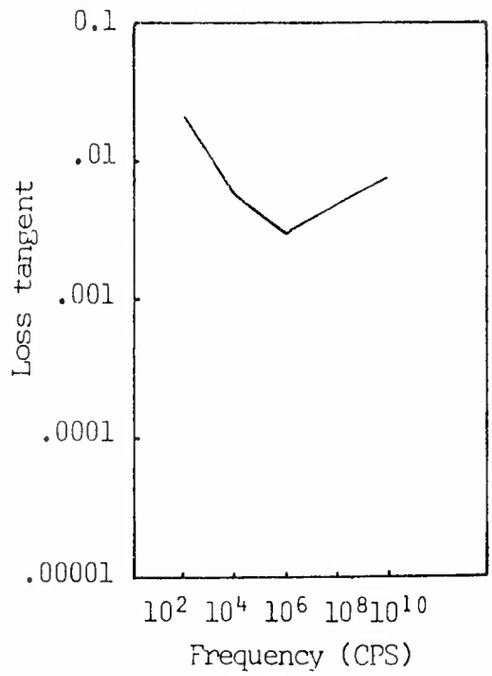
[Ref. 1261]

# INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9608

Dissipation Factor




Loss tangent as a function of frequency for Corning 9808 at room temperature.

[Ref. 1261]

# INSULATION MATERIALS

August 1963

PYROCERAM - Corning 9608

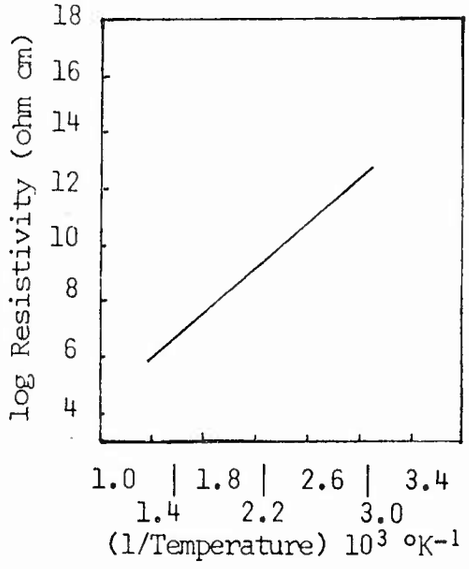
Loss Factor

| Temperature (°C) | Frequency (CPS) | Loss Factor | Ref. |
|---|---|---|---|
| 25 | $10^6$ | 0.020 | 5789, 5791, 5793 |
| 25 | $10^{10}$ | 0.045 | 5789, 5791 |
| 300 | $10^{10}$ | 0.077 | 5789, 5791 |
| 500 | $10^{10}$ | 0.27 | 5789, 5791 |

Volume Resistivity

| Temperature (°C) | Resistivity (ohm-cm) |
|---|---|
| 250° | $1.1 \times 10^8$ |
| 350 | $1.6 \times 10^6$ |

[Ref. 5788, 5789, 5791, 5790, 5793]




Relation between d-c resistivity and temperature for Corning 9808.

[Ref. 1261]

## INSULATION MATERIALS

August 1963

PYROCERAM - Unknown Code Designation

Dielectric Constant

| Temperature (°C) | Frequency (CPS) | $\varepsilon'$ | Ref. |
|---|---|---|---|
| 25 (?) | $10^6$ | 5.5 to 6.3 | 4835 |

Dissipation Factor

| Temperature (°C) | Frequency (CPS) | Tan $\delta$ | Ref. |
|---|---|---|---|
| 25 (?) | $10^6$ | 0.0017-0.013 | 4835 |

Loss Factor

| Temperature (°C) | Frequency (CPS) | Loss Factor | Ref. |
|---|---|---|---|
| 25 (?) | $10^6$ | 0.01-0.07 | 4835 |

## PYROCERAM REFERENCES

1261. EICHBAUM, B.R. and P.A. LARSEN. Ceramic and Glass Products. Insulation, vol. 7, no. 6, p. 263-284, May 1961.

4009. KOENIG, J.H. New Developments in Ceramics. Materials in Design Engineering, vol. 47, no. 148, p. 121-136, May 1958.

4834. LARSEN, P.R. When Designing With Ceramic Materials. Product Engineering, vol. 32, no. 22, p. 47-51, May 29, 1961.

4835. EICHBAUM, B.R. Ceramic Electrical Insulation - Part 1. Insulation, vol. 5, no. 8, p. 11-17, August 1959.

4836. EICHBAUM, B.R. Ceramic Electrical Insulation - Part 2. Insulation, vol. 5, no. 9, p. 13-20, September 1959.

5633. AMPHENOL-BORG ELECTRONICS CORP., Chicago, Ill. Research on R.F. Coaxial Connectors, Broadband, High Temperature, Radiation Resistant, by J.V. Malek. Scientific rept. no. 1, 1 Mar - 1 June 59, 42 p. Contract AF 33(616)6243. ASTIA AD-217 940.

5742. LOCKHEED AIRCRAFT CORP., Sunnyvale, Calif. High-Temperature Dielectric Measurements in the VHF Range, by B.M. Newlan. Technical report LMSC 3-80-61-20. Dec 61. Contract NOrd 17017. ASTIA AD-271 183.

5788. CORNING GLASS WORKS, New York. Materials Handbook. January 10, 1958.

5789. CORNING GLASS WORKS, New York. Pyroceram - Codes 9606-9608. Progress Report no. 2. PY-2.

5790. STOOKEY, S.C. Catalyzed Crystallization of Glass in Theory and Practice. Industrial and Engineering Chemistry, vol. 51, no. 7, p. 805-808, July 1958.

5791. CORNING GLASS WORKS, New York. Pyroceram - Codes 9606-9608. Progress Report no. 3. PY-3.

5793. CORNING GLASS WORKS, New York. This is Glass. Booklet. 1961.

5794. DAVIS, J.K. Glass in Modern Electronics. Electronics and Communications, vol. 10, no. 8, p. 24-32, August 1962.

5795. KUSHNERICK, J.P. Pyroceram Nose Cones. Aircraft and Missiles Manufacturing, vol. 1, no. 8, p. 12-15, August 1958.

5796. ANONYMOUS. Pyroceram: A Strong New Ceramic. Materials in Design Engineering, vol. 46, no. 1, p. 142-143, July 1957.

PUBLICATIONS OF THE ELECTRONIC PROPERTIES INFORMATION CENTER

Summary Reviews and Data Sheets

DS-101. Cadmium Telluride - Data Sheets. M. Neuberger. June 1962.

DS-102. Indium Phosphide - Data Sheets. M. Neuberger. June 1962.

DS-103. Indium Telluride - Data Sheets. M. Neuberger. June 1962.

DS-104. Magnesium Silicide - Data Sheets. M. Neuberger. June 1962.

DS-105. Polyethylene Terephthalate - Data Sheets. John T. Milek. June 1962.

DS-106. Polytetrafluoroethylene Plastics - Data Sheets. Emil Schafer. June 1962.

DS-107. Polytrifluorochloroethylene Plastics - Data Sheets. Emil Schafer. June 1962.

DS-108. Zinc Telluride - Data Sheets. M. Neuberger. June 1962.

DS-109. Indium Arsenide - Data Sheets. M. Neuberger. July 1962.

DS-110. Aluminum Antimonide - Data Sheets. M. Neuberger. September 1962.

DS-111. Gallium Phosphide - Data Sheets. M. Neuberger. September 1962.

DS-112. Gallium Antimonide - Data Sheets. M. Neuberger. October 1962.

DS-113. Lead Telluride - Data Sheets. M. Neuberger. October 1962.

DS-114. Magnesium Stannide - Data Sheets. M. Neuberger. October 1962.

DS-115. Gallium Arsenide - Data Sheets. M. Neuberger. November 1962.

DS-116. Lead Selenide - Data Sheets. M. Neuberger. December 1962.

DS-117. Silicon: Absorption - Data Sheets. M. Neuberger. December 1962.

DS-118. Silicon: Debye Temperature - Data Sheets. M. Neuberger. January 1963.

DS-119. Silicon: Dielectric Constant - Data Sheets. M. Neuberger. January 1963.

DS-120. Silicon: Mean Free Path - Data Sheets. M. Neuberger. January 1963.

DS-121. Indium Antimonide - Data Sheets. M. Neuberger. February 1963.

DS-122. Steatite - Data Sheets. John T. Milek. February 1963.

DS-123. Beryllium Oxide - Data Sheets. John T. Milek. March 1963.

DS-124. Cadmium Sulfide - Summary Review and Data Sheets. M. Neuberger. April 1963.

DS-125. Magnesium Oxide - Data Sheets. John T. Milek. June 1963.

DS-126. Silicon: Electrical Conductivity. M. Neuberger. June 1963.

DS-127. Silicone Rubber - Data Sheets. John T. Milek. June 1963.

DS-128. Cordierite - Data Sheets. John T. Milek. July 1963.

DS-129. Forsterite - Data Sheets. John T. Milek. August 1963.

Other Reports

5171.2/8 Information Retrieval Program. Electronic/Electrical Properties of Materials. First Quarterly Report. E.M. Wallace. October 10, 1961.

5171.2/8 Information Retrieval Program. Electronic/Electrical Properties of Materials. Second Quarterly Report. E.M. Wallace. January 15, 1962.

5171.2/32 Information Retrieval Program. Electronic/Electrical Properties of Materials. Third Quarterly Report. E.M. Wallace. April 15, 1962.

P62-18 Electrical and Electronic Properties of Materials Information and Retrieval Program. Final Report. H. Thayne Johnson, Emil Schafer, and Everett M. Wallace. June 1962.

S-1 Insulation Materials Descriptors Used in the Electrical and Electronic Properties of Materials Information Retrieval Program. Emil Schafer. July 1962.

S-2 Semiconductor Materials Descriptors Used in the Electrical and Electronic Properties of Materials Information Retrieval Program. Emil Schafer. September 1962.

5171.2/73 Information Retrieval Program. Electronic/Electrical Properties of Materials. Fourth Quarterly Progress Report. H.T. Johnson. September 15, 1962.

P62-18 Electrical and Electronic Properties of Materials Information Retrieval Program. H. Thayne Johnson, Donald L. Grigsby, and Dana H. Johnson. April 1963.